ERDDAP Tutorial & Demo

CoastWatch West Coast ERDDAP
OceanWatch Central Pacific ERDDAP
APDRC ERDDAP
PACIOOS ERDDAP

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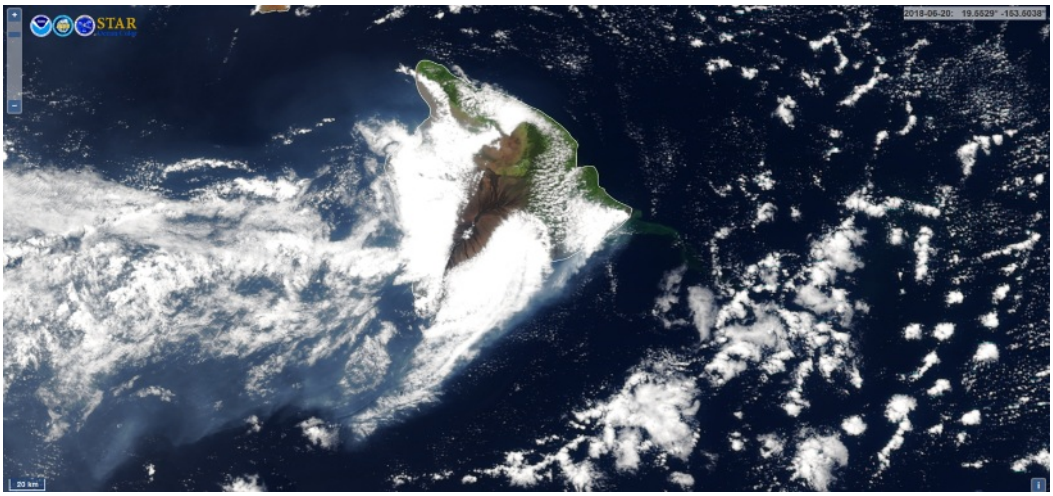
Objective: Showcase the breadth of datasets available on various ERDDAPs and demonstrate how to graph and download data from ERDDAP.

1. Familiarizing yourself with ERDDAP

- ERDDAP was developed by Bob Simons from the NOAA SouthWest Fisheries Science Center
- ERDDAP is a platform to distribute data to users
- Various institutions have installed ERDDAP to allow their users to visualize and download data
- ERDDAP offers a consistent way to get data from a variety of different data sources. A variety of data types can be distributed on ERDDAP: in situ, satellite, or model data among others
- ERDDAP lets you download data in your preferred data file format (netcdf, csv, ESRIcsv, JSON, ODVtext, mat, text and more)
- ERDDAP lets you create images in your preferred image file format (png, transparent png, pdf, kml)
- It supports temporal and spatial subsetting
- It is “RESTful”, meaning the URL completely defines the data you want, in the format you want. This means you can transfer the URL to another application and access the same data from there, for example, in your own webpage, or from your analysis software. You can even email the URL to a colleague and they can access the same data, image or plot that you generated
- So ERDDAP works for both humans and machines!

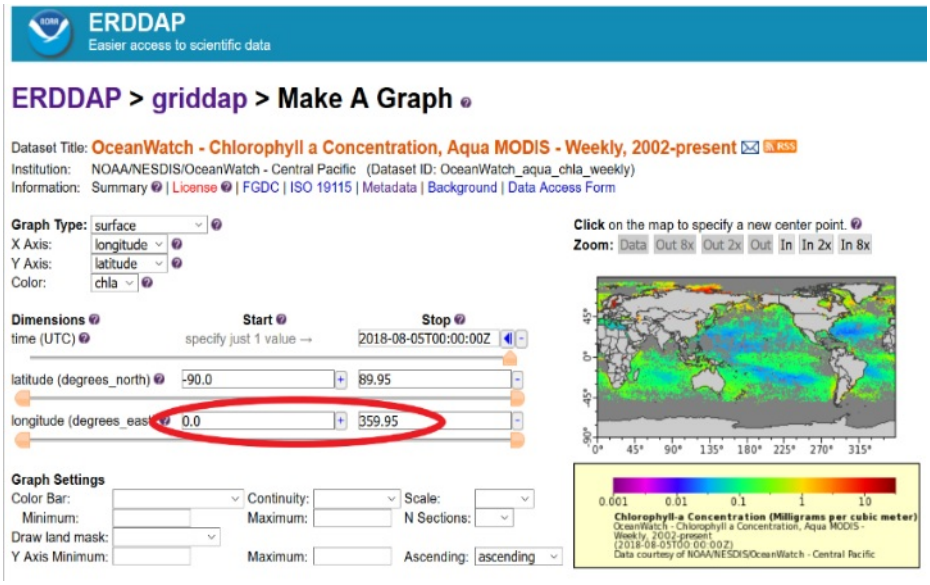
2. Example #1. Examine the Kilauea algae bloom



Following the 2018 lower Puna eruption, an algae bloom was observed off the east coast of the Big Island in June 2018. Let’s see what the chlorophyll concentration data looks like for that period.

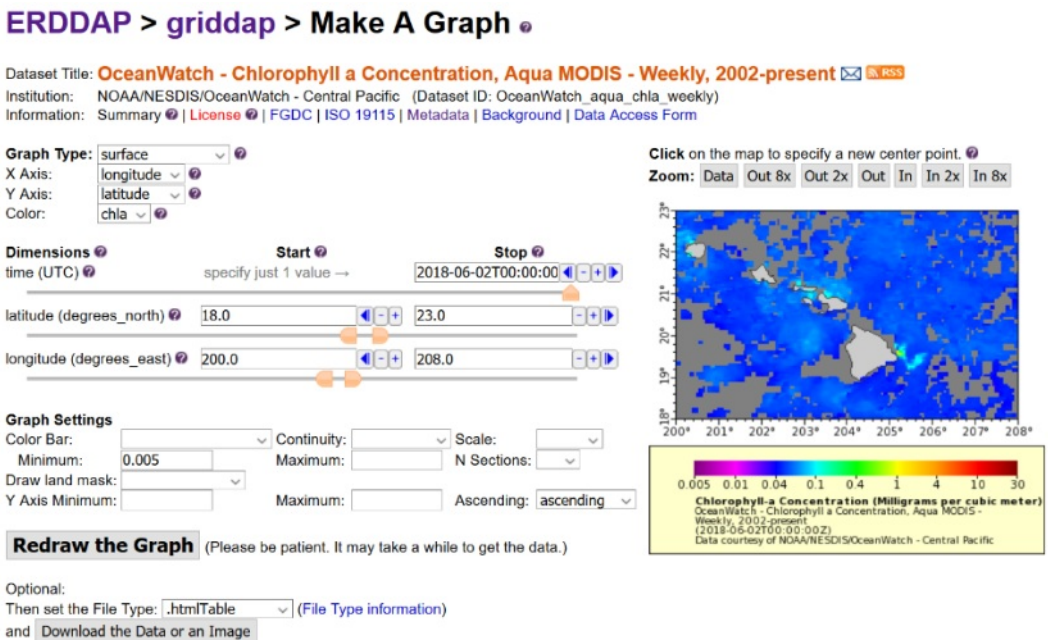
1. Go to the OceanWatch ERDDAP
2. Type “MODIS chlorophyll” in the search box. This will generate a list of choices
3. Hover with your mouse on the question mark in the “Summary” column for some of the rows. This is where you can find a brief description of each dataset
4. Click on the “graph” link to the left of the dataset named “OceanWatch - Chlorophyll a Concentration, Aqua MODIS - Weekly, 2002-present”

   Here is what you should see. You'll notice that for this dataset, longitudes go from 0º to 360º instead of -180º to 180º. This allows users to download data for regions across the dateline. Other data sources, not focused on the Pacific, provide the data with longitudes between -180º and 180º. You should always check the range of longitudes for each dataset you are working with to make sure you are downloading data for the correct region.



5. Enter 18 and 23 as the start and stop latitude and 200 and 208 as the start and stop longitude. Adjust the colorbar minimum to 0.005
6. Click on “redraw the graph”

   Here is what you should see:



   Scroll through the different time steps using the + button next to the date to see the full extent of the bloom. You can also adjust the color scale by setting different values for colorbar minimum and maximum. Don't forget to click on "Redraw the Graph" after you change settings.

7. Under the "redraw the Graph" button, set the file type to ".largePng" and click on the "download" button. Try different file type options (html, PDF, ...)

3. Griddap versus Tabledap

There are two types of data stored on ERDDAP – gridded data (i.e. satellite data) and tabular data (i.e. station or profile data). ERDDAP uses two different functions to deal with the different types of data. Griddap works with gridded data and Tabledap works with tabular data.
Got to the PACIOOS ERDDAP and click on "View a list of all 182 Datasets".

PacIOOS PACIFIC ISLANDS OCEAN OBSERVING SYSTEM

ERDDAP
Easier access to scientific data

ERDDAP > List of All Datasets

182 matching datasets, listed in alphabetical order.

Grid DAP Data	Sub-set	Table DAP Data	Make A Graph	WMS	Source Data Files	Title
	set	data	graph			* The List of All Active Datasets in this ERDDAP *
		data	graph			AIS Ship Traffic: Hawaii: 2011-2012
		data	graph			AIS Ship Traffic: Johnston Atoll: 2011-2012
		data	graph			AIS Ship Traffic: Mariana and Wake: 2011-2012
		data	graph			AIS Ship Traffic: Rose Atoll: 2011-2012
		data	graph			ALOHA Cabled Observatory (ACO): Acoustic Doppler Current Profiler (ADCP): Temperature
		data	graph			ALOHA Cabled Observatory (ACO): Acoustic Doppler Current Profiler (ADCP): Velocity
	set	data	graph			ALOHA Cabled Observatory (ACO): Bottom Pressure Recorder (BPR)
	set	data	graph		files	ALOHA Cabled Observatory (ACO): Hydrophone Acoustics
data			graph	M		Distance from Nearest Coastline: 0.01-Degree Grid
data			graph	M		Distance from Nearest Coastline: 0.04-Degree Grid
data			graph	M		ETOPO5 Global Surface Relief
		data	graph			Hawaii Clean Water Branch (CWB) Beach Water Quality Data
	set	data	graph			Hui O Ka Wai Ola Water Quality Data
data			graph	M		HYbrid Coordinate Ocean Model (HYCOM): Global: 2-D Variables
data			graph	M		HYbrid Coordinate Ocean Model (HYCOM): Global: 3-D Variables

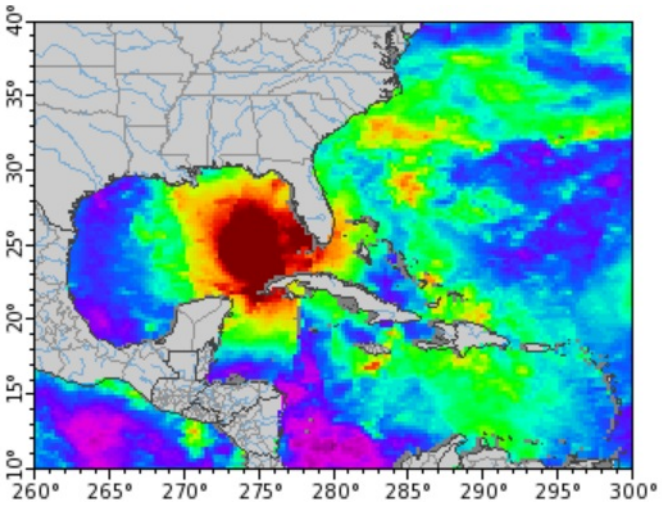
You can see that there is a "GridDAP" column and a "TableDAP" column, corresponding to different datasets.

4. Example #2. Look at RAMP fish counts

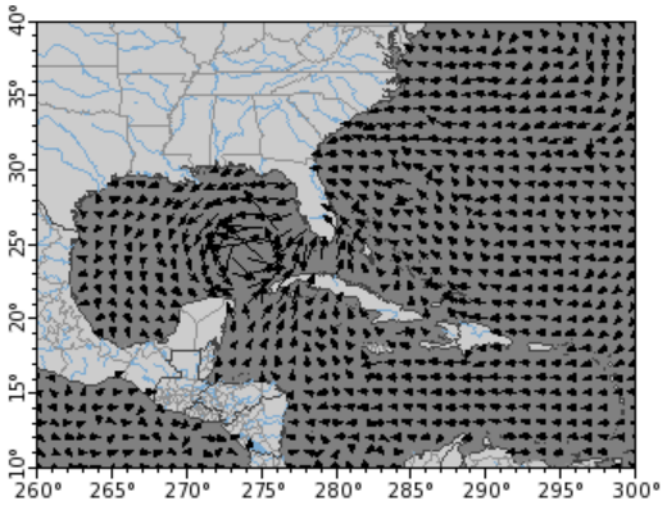
1. Go to the PACIOOS ERDDAP
2. Type "Fish surveys" in the search box
3. Click on the "graph" link to the left of the dataset named "Northwestern Hawaiian Islands, Coral Reef Monitoring, Fish Surveys, Stationary Point Counts (nSPC)"
   The map will come up showing the positions of fish surveys, colored by values of fish count. Under "Constraints", you can use the drop down menu to subset the data.
4. Change the latitude constraint to only view fish counts north of 26N by selecting "latitude" in the drop down menu, ">=" and typing 26 in "optional constraint #1"
5. Click on "Redraw the graph"
6. Use additional constraints to find which island north of 26N had more than 10 ulua (*Caranx ignobilis*)

5. Look at wind data from Hurricane Katrina

1. Go to the OceanWatch ERDDAP
2. Type "QuikSCAT" in the search box
3. Click on the "graph" link to the left of the dataset named "OceanWatch - Ocean Surface Winds, QuikSCAT - 3-Day, 1999-2009"
4. Change the region to 10-40N, 260-300E
5. Change the date to 08/26/2005

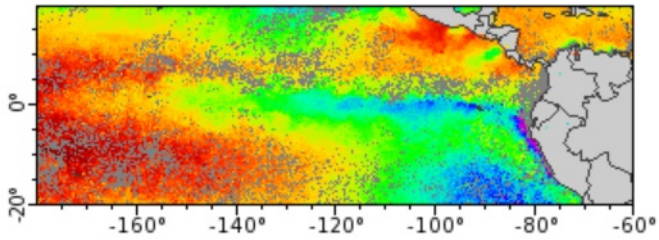


6. Change the "Graph Type" to "vectors"
7. Change "Vector X" to "ux" and "Vector Y" to "vy"



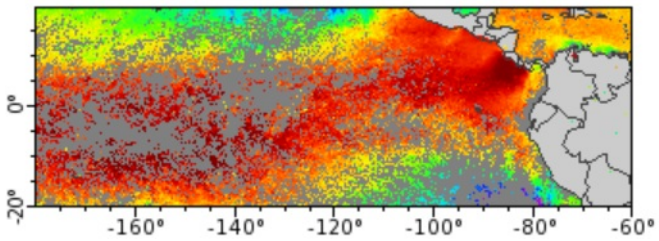
6. Example #4. Examine the 1998 El Niño

1. Go to the OceanWatch ERDDAP
2. Type "pathfinder 5.2" in the search box
3. Click on the "graph" link to the left of the dataset
4. Make a map of SST for January 1997, for the region: -20 - 20N, -180 to -60, and adjust the color scale to 18-30ºC
5. Click on "Redraw the Graph"



You'll notice there are some missing pixels (in gray), due to clouds, even though this is a monthly composite.

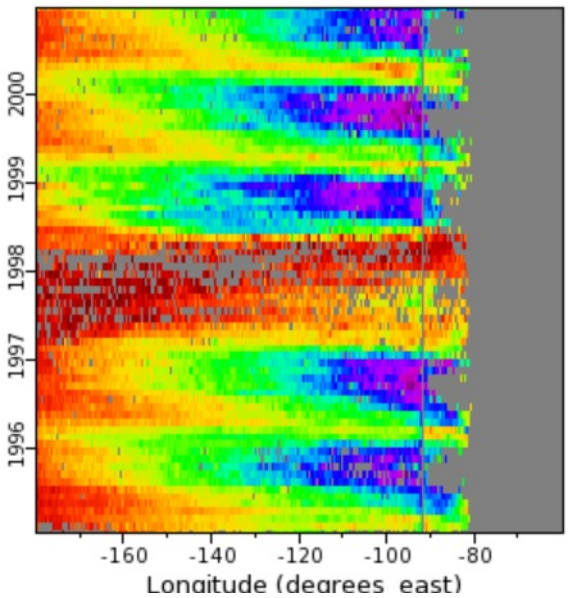
6. Make a map of SST for January 1998, for the region: -20 - 20N, -180 to -60, and adjust the color scale to 18-30ºC
7. Click on "Redraw the Graph"



We can clearly see the tongue of warm water due to the 1998 El Niño.

Now let's make a Hovmöller plot:

1. Below "Graph Type", select "time" in the drop down menu for "Y Axis".
2. Adjust the date range to jan. 1995 - Dec. 2000
3. Adjust the latitude to 0º, and the longitude to -180 to -60º
4. Adjust the color scale to 18-30ºC
5. Click on "Redraw the Graph"



Again, the winter of 1998 was clearly anomalous compared to other years.

7. Understanding the URL generated by ERDDAP

Do you have a graph you like? Want to save it or send it to someone? Change the drop-down menu next to “set the File Type” to png and click on “download the data”, that will create a png file with just that image in it.
You can copy the url and send it to someone which will recreate the image. The url can also be edited.

We’ll walk through some examples using the url created in Example #1:

https://oceanwatch.pifsc.noaa.gov/erddap/griddap/OceanWatch_aqua_chla_weekly.graph?chla[(20
06-02T00:00:00Z)][(18.0):(23.0)][(200.0):
(208.0)]&.draw=surface&.vars=longitude%7Clatitude%7Cchla&.colorBar=%7C%7C%7C0.005%7C%

- OceanWatch_aqua_chla_weekly is the name of the dataset. We could use OceanWatch_aqua_chla_monthly instead
- Changing graph to png or largePng will create a png file of the image
- Changing graph to .csv will download a CSV file to your computer. A complete list of the available file format options can be viewed in the dropdown menu next to “Set the File Type”
- Changing graph to html will bring up the form to download the data
- chla is the name of the variable. Some datasets contain several variables. For example, wind data typically has a wind speed variable, a u-component variable and a v-component variable.
- We can change the date
- Changing the date to last will ensure the graph always plots the most recent data
- and we can change the range of latitudes and longitudes

8. Example #5. On your own. Chlorophyll time series

1. First, create a map of a monthly composite of AQUA MODIS chlorophyll concentration around Hawaii for the date of your choice.
2. Create a time series of monthly chlorophyll concentration for a location close to Honolulu.**Hint:** you will need to change the "Graph Type". Make sure to select of few years worth of data. Make sure your longitude is within the correct range.
3. If there are gaps or outlier values, try again for a location further south (i.e. slightly further from the coast and shallow water)
4. Do you see any seasonal variation?
5. Download the time series data as a .csv file
6. Select a date for a period of low chlorophyll and create a map in a new browser window for that date
7. Open a new browser window, copy and paste the URL for the first map and create a map for a period of high chlorophyll by changing only the date in the URL
8. Compare the two maps and save them as .png

9. Getting the data

You can easily download any of the data on ERDDAP in a variety of different formats: .ncdf, .mat, .asc, etc.
To the left of any dataset on the main ERDDAP page, click on “data” instead of "graph".
ERDDAP generates a Data Access Form, where you can specify constraints to get the data you need: time range, latitude range, longitude range, altitude, data variables, and file type. You can then access the resulting data file via a URL, or use the Submit button to download the file to your computer.

If you are making a graph of the data (on the page that says “Make A Graph”) just click on the “Data Access Form” link above the graph. You can also access this form by replacing the “.graph” in the url with “.html”.

If you access the “Data Access Form” page from a “Make A Graph” page, any constraints you have put in your graph will be transferred to the access form.
You can download a time series of gridded data – ie not just one map, but an entire time series of that map. The **NetCDF** format is recommanded in that case.

10. Using ERDDAP URLs in your software application

ERDDAP URL’s can be used to directly access data in any application, programming language or scripting language that can send a URL and receive a file (such as Python, Java, php, JavaScript, shell scripts using “curl” or “wget”), as well as from OPeNDAP-enabled applications clients such as R, Matlab, GrADS, Ferret, and IDL. Many programming and scripting languages such as Java, python, php, and JavaScript can manipulate ERDDAP URL’s to import data for research or modeling, or for use in dynamic web pages.